

[d. a control unit connected to the measuring device and the pumping unit; wherein the control unit is adapted and arranged for controlling the pumping unit output based on the measurements of the measuring device.

²~~2~~1. The device of claim ¹~~20~~, wherein the pumping unit output is selected from the group consisting of the metering rate and quantity of fluid.

³~~2~~2. The device of claim ¹~~20~~, wherein the pumping unit has a driving device and a piston.

⁴~~2~~3. The device of claim ³~~22~~, wherein the piston includes a piston head and a piston shaft.

⁵~~2~~4. The device of claim ⁴~~23~~, wherein the measuring device is adapted to measure the pumping unit output by determining the axial position of the piston.

⁶~~2~~5. The device of claim ¹~~20~~ where the measuring device includes sensors selected from the group consisting of optical, electromechanical and electrical sensors.

⁷~~2~~6. The device of claim ³~~22~~, wherein the piston is arranged on a chassis.

⁸~~2~~7. The device of claim ¹~~20~~, wherein the membrane has a first and a second layer of a non-stretching material forming an interspace therebetween, the interspace being filled with a non-compressible medium such that the membranes have an outward bulge.

⁹~~2~~8. The device of claim ⁸~~27~~, wherein the non-compressible medium is a spacer.

¹⁰~~2~~9. The device of claim ⁴~~23~~, wherein the measuring device is adapted and arranged to determine the axial position of the piston shaft.

¹¹~~3~~0. The device of claim ²~~21~~, further comprising a computer connected to the measuring device and the control unit, wherein the computer is adapted for calculating parameters for the pumping device, wherein the parameters are selected from the group consisting of volume of fluid delivered, metering rate or delivery rate.

31. The device of claim 20, further comprising a hydraulic sensor in fluid connection with the hydraulic unit, the hydraulic sensor adapted and arranged for measuring the pressure of the fluid within the hydraulic unit.

32. The device of claim 31, wherein the control unit is connected to the hydraulic sensor and wherein the control unit is adapted for shutting off the pumping unit in response to a measured pressure outside a predetermined range.

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33. The device of claim 22, wherein the driving device includes a linear drive.

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34. The device of claim 33, wherein the linear drive is selected from the group consisting of eccentric drives, spindle drivers, rack and pinion drives, pneumatic pistons and compressor drives.

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35. The device of claim 1 wherein the hydraulic unit includes a vent valve.

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36. The device of claim 30 wherein the computer is integrated into the control unit.

37. A pumping device for delivering and metering medical fluids comprising:

- a. a membrane having a first membrane bordering a first chamber;
- b. a membrane pump head mounted on the membrane unit, the membrane pump head having a second membrane bordering a second chamber, the second chamber having an inlet and an outlet for conveying medical fluids and wherein the second membrane is in air-free contact with the first membrane;
- c. a pumping unit connected to the first chamber by a hydraulic unit containing hydraulic fluid that is in fluid connection with the first chamber;
- d. a measuring device for measuring the pumping unit output; and
- e. a control unit connected to the measuring device and the pumping unit, the control unit being adapted and arranged for controlling the pumping unit

output based on the measurements of the measuring device;
wherein movement of fluid in the first chamber induces movement of fluid in the second chamber.

38. The device of claim 37, wherein the movement of fluid out of the first chamber induces the movement of fluid into the second chamber.

39. The device of claim 37, wherein the membrane pump head is detachably mounted on the membrane unit.

40. The device of claim 37, wherein closing means are provided for closing the inlet and outlet of the second chamber.

41. The device of claim 40, wherein the closing means are selected from the group consisting of clamps or valves.

42. The device of claim 37, further comprising a hydraulic sensor in fluid connection with the hydraulic unit, the hydraulic sensor adapted and arranged for measuring the pressure of the hydraulic fluid.

43. The device of claim 42, wherein the control unit is connected to the hydraulic sensor and wherein the control unit is adapted for shutting off the pumping unit in response to a measured pressure outside a predetermined range.

44. A pumping device for delivering and metering medical fluids comprising:

- a. a membrane unit having a first membrane bordering a first chamber;
- b. a membrane pump head mounted on the membrane unit, the membrane pump head having a second chamber bordered by the first membrane on the side opposite the first chamber, the second chamber having an inlet and an outlet for conveying medical fluids;
- c. a pumping unit connected to the first chamber by a hydraulic unit

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d. a measuring device for measuring pumping unit output; and

e. a control unit connected to the measuring device and the pumping unit, the control unit being adapted and arranged for controlling the pumping unit output based on the measurements of the measuring device;

wherein movement of fluid in the first chamber induces movement of fluid in the second chamber.

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45. The device of claim 44, wherein the membrane pump head is detachably mounted on the membrane unit.

46. A method of pumping medical fluids comprising the steps of:

a. providing a fluid to be treated to a device comprising:

i. a membrane having a first membrane bordering a first chamber;

ii. a membrane pump head mounted on the membrane unit, the membrane pump head having a second membrane bordering a second chamber, the second chamber having an inlet and an outlet for conveying medical fluids and the second membrane is in air-free contact with the first membrane;

iii. a pumping unit connected to the first chamber by a hydraulic unit containing hydraulic fluid that is in fluid connection with the first chamber;

iv. a measuring device for measuring the pumping unit output; and

v. a control unit connected to the measuring device and the

pumping unit, the control unit being adapted and arranged for adjusting the pumping unit output based on the measurements of the measuring device;

wherein movement of fluid in the first chamber induces movement of fluid in the second chamber;

b. reducing the pressure on the hydraulic fluid in the hydraulic unit such that the fluid to be treated flows out of the first chamber, thereby causing fluid to flow into the second chamber through the fluid inlet;

c. applying pressure to the hydraulic fluid in the hydraulic unit via the pumping unit such that fluid is forced into the first chamber; wherein the movement of the first membrane forces fluid out of the second chamber through the fluid outlet;

d. measuring the pumping unit output and transmitting the measurement to the control unit; and

e. adjusting the pumping unit output.

47. The method of claim 46, wherein the pumping device further includes a computer connected to the control unit, the computer adapted and arranged for calculating pumping unit parameters selected from the group consisting of volume of fluid delivered, metering rate and delivery rate, and wherein the method further includes the step of calculating a pumping unit parameter.

REMARKS

Claims 20 through 47 are pending in the current application. The amendments are intended to clarify the Applicants' invention and correct informalities in the application.